Indian Res. J. Genet. & Biotech. 10(1): 113-119 Feburary (2018)

Genetic Variability and Character Association Studies in BhutJolokia(*Capsicum chinense*Jacq.)

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(Received : December, 2017 : Revised : January, 2018; Accepted : January, 2018)

Abstract

High estimates of GCV and PCV were recorded for fruit yield per plant, number of seeds per fruit, leaf area number of fruits per plant and fruit weight. High heritability coupled with high genetic advance was recorded for fruit yield per plant. Therefore direct selection for fruit yield per plant would be effective in breeding for high yield in bhutjolokia crop. The other characters that could be effective selection criteria were plant height, number of leaves per plant, number of fruits per plant and number of seeds per fruit. From path analysis it could be concluded that the number of primary branches and fruit width exerted positive direct effects and were positively correlated with fruit yield per plant. Thus by considering both genetic parameters and character relationships number of leaves per plant, days to emergence of flower bud, fruit width, number of primary branches per plant, number of fruit per plant and harvest duration could be further exploited for crop improvement to develop suitable plant type

Key words: Genetic variability, Correlation coefficient, Path coefficient, Bhutjolokia

Introduction:

Chilli (*Capsicum annum* L.), a spice-cum-vegetable crop having high commercial importance is cultivated worldwide. It is cultivated exclusively in tropical and temperate zones of the world and grown on more than 1.5 million hectares worldwide (FAO, 2007). There exist a wide diversity in chilli and are usually classified based on fruit characteristics including pungency, colour, shape, flavour, size and uses. They are consumed in green or dried ripe form and are an indispensable adjunct in every household nowadays. India is the largest producer, consumer and exporter of chillies in the world. It contributes about 36% to global chilli production and exports about 20% of its total production. Bhutjolokia(*Capsicum chinense*Jacq.) plant is location specific; hence, the plants of the same genotypes grown under different environmental condition vary from one another in various aspects which prove to be a boon to bring about improvement for efficient breeding works. Development of an effective breeding programme is dependent upon the existence of genetic variability. In the present investigation an attempt has been made to collect various genotypes from different North Eastern parts of India since this region presents an ample opportunity for commercial cultivation owing to its diverse agro climatic condition coupled with fertile soil condition. Though research on characterization of Bhutjolokia has been done by different workers, its results are varied. Therefore taking into consideration, the existence of wide germplasm variability, a pertinent need was felt to undertake this investigation on genetic variability and

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Published by Indian Society of Genetics, Biotechnology Research and Development,
5, E Biotech Bhawan, Nikhil Estate, Mugalia Road, Shastripuram, Sikandra, Agra 282007
Online management bywww.isgbrd.co.in

characterassociation studies in Bhutjolokia" to identify genotypes which can be commercially exploited.

Materials and Methods:

The present investigation was carried out during 2012-13 in randomized block design with three replications to evaluate the performance of 11 Bhutjolokia genotypes. All the recommended agronomic practices were followed for raising a good crop. For evaluation of the genotypes in the field condition, observations were recorded on per plot basis for the character days to emergence of flower bud, harvest duration, days to maturity and seed germination percentage. For plant height, number of primary branches, number of leaves, leaf area, number of flowers per cluster, number of fruits, fruit length, fruit width, fruit weight, volume of fruits, fruit yield, storage life of fruit, number of seed per fruit and 1000 seed weight observations were recorded on per plant basis by random sampling of five competitive plants per plot.Analysis of variance was done by using the standard statistical procedure. Heritability (broad sense) was estimated according to Allard (1960). Genotypic and phenotypic coefficients of variation were estimated following Burton (1952). Genetic advance as per cent of mean was estimated according to Johnson et al. (1955). Genotypic and phenotypic correlation coefficients for all possible comparisons were computed by formulaesuggested by Al- Jibouri et al. (1958). The partitioning of genotypic correlation coefficient of traits into direct and indirect effects was carried out using the procedure suggested by Dewey and Lu (1959).

Result and Discussion:

Aanalysis of variance revealed highly significant difference among the genotypes for all the characters.In the present study the genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability and genetic advance has been estimated to know the existence of variability for different characters. Different Genetic parameters viz., Genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability (h^2)and genetic advance(GA) were calculated for all the characters under study and the results are presented in Table 1. In the present investigation the estimates of PCV was higher than the GCV for all the 18 characters studied.

The estimates of GCV when compared among different characters fruit yield per plant showed the highest GCV (33.14 %) followed by number of seeds per fruit (30.58%) and leaf area (27.73%). Low estimates of GCV were exhibited by days to harvest maturity (2.97%), 1000 seed weight (3.33%) and storage life of fruit (4.57%).

The highest PCV (37.01%) was exhibited by fruit yield per plant followed by number of seeds per plant (29.03%) and the lowest value was observed in days to harvest maturity (3.38%). From the Table 4.6.1 it is clear that the PCV was higher than GCV for all the characters under study while the difference between GCV and PCV was also low for all characters indicating less effect of environment on these characters. Higher GCV and PCV for fruit yield was also reported by Sahoo*et al.* (1990)

For selecting any character effectively the amount of variability cannot be depended alone. A breeder might want to determine how much of the phenotypic variability present in the particular generation is heritable. The estimates for heritability study revealed that leaf area (99.87%) showed the highest heritability in broad sense followed by number of seeds per fruit (97.00%) and harvest duration (96.00%).

Number of primary branches showed the least estimates of heritability (24.02%).

Again the breeding value may not be predicted clearly by the heritability value alone hence heritability along with genetic advance are usually more useful than heritability alone in predicting the resultant effect of selecting the best individuals (Johnson *et al*., 1955). This is because a character may have very high heritability but very less phenotypic variation thus giving low values of genetic advance. In the present study there was a wide variation for different characters for the genetic advance as percentage of mean. It was highest for fruit yield per plant (316.20%) followed by number of fruits per plant (42.82%) and number of leaves per plant (34.51%). High heritability along with high genetic advance as percentage of mean in this study suggested the role of additive genes in the expression of the character, which would effectively be improved upon selection. In this experiment it was found that the characters such as plant height, number of leaves per plant, number of fruits per plant, fruit yield per plant and number of seeds per fruit showed high heritability coupled with high genetic advance. Hence these characters can be further exploited for crop improvement to develop suitable plant type. High heritability along with moderate genetic advance as per cent of mean was also recorded for characters such as leaf area, days to emergence of flower bud, harvest duration and seed germination percentage. Sufficient genetic variability for many horticultural traits were also reported in chilli by Sarkar*et al.* (2009), Wasule*et al.* (2004) and Verma*et al.* (2004)). Low genetic advance was estimated for number of primary branches (0.34%) closely followed by storage life of fruits (0.35%) and 1000 seed weight (0.41%).

Table:1 Estimates of genetic parameters for different characters in Bhutjolokia

Characters	Components of variance (%)		Heritability (h^2) (%)	Expected genetic advance
	GCV	PCV		
Plant height	19.64	20.23	94.28	26.64
No. of primary branches	7.90	16.12	24.03	0.34
Number of leaves/plant	13.18	15.92	68.58	34.51
Leaf area	27.73	27.75	99.87	18.8
Days to emergence of flower bud	10.30	11.02	87.28	19.11
Total number of flower/cluster	18.87	22.66	69.29	1.07
Number of fruits/plant	25.74	29.03	78.61	42.82
Fruit width	13.83	16.96	66.46	0.66
Fruit length	14.50	16.91	73.48	1.39
Fruit weight	21.01	22.71	85.61	2.26
Size /vol of fruits	13.32	14.84	80.59	5.87
Fruit yield/ plant	33.14	37.01	80.19	316.2
Days to harvest maturity	2.97	3.38	77.29	8.99
Harvest duration	12.54	12.76	96.00	12.89
1000 seed weight	3.33	6.27	28.23	0.41
No. of seeds/fruit	30.58	31.08	97.00	30.32
Seed Germination %	9.54	10.33	85.35	13.33

Storage life of fruit	4.57	8.61	28.24	0.35

Table: 2. Genotypic correlation coefficients between different characters in Bhutjolokia

Characters	Plant height	No. of primary branches	No. of leaves/ plant	Leaf area	Days to emergence of flower bud	Total no. of flowers/cluster	No. of fruits/ plant	Fruit width	Fruit length	Fruit weight	Vol. of fruits	Fruit yield/ plant	Days to harvest maturity	Harvest duration	1000 seed weight	Seeds /fruit	Seed germination %	Storage life of fruits
Plant height	1	0.229	-0.500**	0.224	-0.614	-0.286	-0.103	0.631**	0.163	0.644**	0.441*	-0.226	0.116	-0.159	0.175	0.808**	0.543**	-0.412*
No.ofprimary branches		1	0.498*	0.083	0.067	0.019	0.269	0.272	0.693**	-0.097	0.402*	0.431*	-0.259	-0.079	0.188	0.188	0.516**	0.197
No. of leaves/ plant			1	-0.226	0.593**	0.233	0.399	-0.560**	0.090	-0.475*	-0.501**	0.399	-0.278	-0.123	-0.032	-0.317	-0.033	0.386
Leaf area				1	0.283	0.568**	0.282	0.442*	0.568**	0.650**	0.694**	0.312	-0.759**	0.369	0.331	0.312	0.534**	-0.044
Days to emergence of flower bud					1	0.531**	0.432*	-0.315	0.012	-0.217	-0.413*	0.541**	-0.738**	0.275	0.059	-0.278	0.093	0.219
Total no. of flowers/cluster						1	0.2197	-0.124	0.686**	0.444*	0.288	0.218	-0693**	0.074	0.097	-0.025	0.301	-0.612**
No. of fruits/ plant							1	0.385	0.151	-0.092	-0.180	1.034	-0.290	-0.121	0.022	0.270	-0.099	0.298
Fruit Width								1	0.089*	0.468*	0.457*	0.359	-0.039	0.188	0.049	0.856**	0.259	-0.239
Fruit length									1	0.610**	0.685**	0.276	-0.510**	0.015	0.212	0.150	0.283	-0.208
Fruit weight										1	0.668**	-0.129	-0.523**	0.339	0.247	0.523**	0.505**	-0.371
Vol. of fruits											1	-0.112	-0.205	0.109	0.36	0.236	0.464*	-0.261
Fruit yield/ Plan												1	-0.402*	0.051	0.068	0.139	-0.197	0.455*
Days to harvest maturity													1	-0.603**	-0.238	-0.050	-0.454*	-0.051
Harvest duration														1	0.161	-0.064	-0.041	0.697**
1000 seed weight															1	0.155	0.316	-0.042
Seeds/fruit																1	0.477*	-0.478*
Seed germination %																	1	-0.676**
Storage life of fruits																		1

*Significant at 5% level of significance, **Significance at 1% level of significance

Table: 3 Direct and indirect effects of some component characters on fruit yield per plant in Bhutjolokia.

Characters	No. Of primary branches	Fruit length	Fruit width	Fruit weight	Days to flower bud emergence	No. of fruits/plant	Days to maturity	Harvest duration	No. of seeds/fruit
No. Of primary branches	**0.3641**	-0.0638	0.3533	-0.0998	-0.3578	0.0136	0.2491	-0.0029	-0.0241
Fruit length	-0.0246	**-0.9439**	0.5672	0.1158	-0.0066	0.0304	0.7082	0.0099	0.0356
Fruit width	0.0981	-0.4082	**1.3116**	-0.1413	-0.0779	0.0129	0.2786	-0.0044	-0.0345
Fruit weight	0.0991	0.2981	0.5054	**-0.3666**	-0.0459	-0.0655	0.0378	0.0068	-0.1095
Days to flower bud emergence	0.2526	-0.0122	0.1982	-0.0326	**-0.5156**	-0.0854	0.4898	0.0006	-0.0193
Number of fruits/plant	-0.0355	0.2054	-0.1208	-0.1717	-0.3149	**-0.1399**	0.5024	0.0123	-0.0669
Days to maturity	-0.0945	0.6969	-0.3807	0.0144	0.2631	0.0732	**-0.9599**	-0.0218	0.0064
Harvest duration	-0.0288	-0.2598	-0.1592	-0.0691	-0.0079	-0.0475	0.5793	**0.0361**	0.0082
Number of seeds/fruit	0.0685	0.2632	0.3545	-0.3142	-0.0777	-0.0732	0.0484	-0.0023	**-0.1278**

From Table 2, it can be observed that at genotypic level yield displayed significant and positive association with number of leaves per plant, days to emergence of flower bud and number of fruit per plant. The results indicated that these traits have certain inherent positive relationship with yield and their importance could be suggested in determining fruit yield. This is in concurrence with the findings of Waradee*t al*. (1996)

The correlation coefficients are separated into direct and indirect effects with the help of path coefficient analysis. It is used to establish the relative importance of causal factors in determining the yield per plant (Table 3).

An insight into the magnitude of the direct effects contributed by independent variables to yield per plant showed that fruit width (1.311) had the maximum positive direct effect on fruit yield followed by number of primary branches (0.364) and harvest duration (0.0361). Considerable positive indirect effects of fruit width via number of primary branches per plant, days to emergence of flower bud, fruit length, fruit weight and number of seed per fruit and indirect effect through number of fruit per plant, days to harvest maturity and harvest duration were observed. In addition, the indirect effects of fruit length via fruit weight, number of fruits per plant days to maturity and number of seed per fruit were found contributing kind.

Fruit length, fruit weight, days to emergence of flower bud and number of seed per fruit showed negative direct effect on fruit yield per plant but its correlation with yield was positive. The positive correlation was mainly due to positive indirect effects through other component characters.The above mentioned correlations between the fruit yield component traits depicted that simultaneous improvement of several traits could be made by selecting one of the characters as they were inherited together (Ahmed *et al.*, 1994).

Therefore, from correlation and path analysis the characters; fruit width, number of primary branches and harvest duration exerted positive direct effects and were positively correlated with fruit yield per plant and thus these characters deserve consideration in breeding programme as selection criteria to bring about improvement in fruit yield. Thus by considering both genetic parameters and character relationships viz., number of leaves per plant, days to emergence of flower bud, fruit width, number of primary branches per plant, number of fruit per plant and harvest duration could be effective selection criteria.

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